**DARPA-BAA-15-16 Fast Lightweight Autonomy (FLA)**
**Frequently Asked Questions (FAQs)**
**as of 1/26/2015**

Q162. The first phase requires outdoor testing. Is there a test area that will be made available for outdoor testing to ensure FAA compliance?

> A162. The Government-run tests will take place in locations that comply with all federal, state, and local regulations, including FAA regulations. Developmental testing is the responsibility of the performer teams as is compliance with all applicable laws and regulations.

Q161. Is there a height limit on UAV flight (especially during outdoor tests)?

> A161. DARPA expects that for safety and compliance with regulations it may be necessary to impose height limits during Government-run tests. The height limits are not known at this time, and will likely depend on the test venue, and may vary from venue to venue. Also see Q/A162.

Q160. Section I.E. (page 8) of the BAA, states that the Government requires the Offeror in Phase 1 to "test and demonstrate the software by running it on the GFE Platform in progressively more challenging tasks with a relatively moderate density of clutter." In order to achieve that Phase 1 requirement, the Offeror must be able to test its software on a Platform in a similar environment at the Offeror's facility. However, current FAA requirements state that use of a UAV for "commercial" purposes must receive prior FAA approval. (Note, private use of UAV does not require FAA approval though there are several guidelines on where, and where not, the UAV can be flown.). Since the Offeror will be using Government funds to "commercially" use a UAV for the testing of its software at its facility to meet the Phase 1 test and demonstration at a Government facility, does DARPA expect the Offeror to seek FAA approval for the Offeror's UAV use at the Offeror's facility? If so, does DARPA require any specific statement (or proof) in the Offeror proposal of having initiated the process of said FAA approval?

> A160. While it is not required that FLA proposals include proof of FAA approval, it is recommended that FLA performers keep a record of any such approvals in the event that it is requested during the performance of the FLA award. It is the responsibility of the proposer to comply with applicable laws and regulations.

Q159. According to the manufacturer, the mini-PC (BXi7-4500) has an input voltage range of 18V-19V. Will the GFE have a power supply port at this voltage or will the developers need to supply/regulate a power source to that voltage range?

> A159. The mini-PC has been tested with the voltage provided by a 4-cell battery without the need for an additional regulator.

Q158. Is the RAM and/or hard drive provided with the GFE GigaByte i7 mini-PC?

> A158. The planned standard configuration will include 16GB of DDR3 RAM and a 250GB SSD drive.

Q157.  Did DARPA fund any seedlings in connection with this BAA?  If yes, can you provide details on who executed these efforts and what capabilities were developed/demonstrated?

> A157. There were seedlings funded by DARPA that, among other things, assisted with establishing the feasibility of high-speed flight in cluttered environments, i.e., the premise of the FLA program.

Q156.  The BAA specifies: "Intellectual property rights asserted by proposers are strongly encouraged to be aligned with open source regimes. See Section VI.B.1 for more details on intellectual property." What does this mean and what are the consequences for proposals that do not align with open source regimes?  Does this mean that proposals that do not align with open source regimes will be negatively affected in the review process?   Does it mean that proposals that do not align with open source regimes will still be given full merit and consideration?  Is it possible to provide the rationale behind such encouragement for open source regimes, given the understanding that the technological advances supported by DARPA with the program will then be readily available to foreign nations under open source regimes?

> A156.  The FLA program encourages open source in order to enable wide usage and testing of the software by the community, thereby increasing the chances of higher quality software.  Per the BAA Section V.A., proposal evaluation will include considering the extent to which any proposed intellectual property restrictions will potentially impact the Government's ability to transition the technology.  Per Section VI.B.1, if proposals include proprietary software and/or technical data as the basis of the proposed approach, proposal should also include an explanation of how the Government will be able to reach its program goals (including transition) within the proprietary model offered; and provide possible nonproprietary alternatives in any area that might present transition difficulties or increased risk or cost to the Government under the proposed proprietary solution.

Q155.  Page 7 of the BAA states that the performance goals from Table 1 will be used in addition to the mission performance metrics to determine which performers advance to Phase II. Is there any desire to surpass the performance goals or should they just be considered binary gates? For example, would DARPA value an approach that posts an average mission completion time in the technical milestone tests but significantly surpasses the power, range, and duration goals?

> A155. Proposers are free to propose power, range, and duration Performance Goals above those outlined in the BAA; however, if these lead to an inability to meet the Performance Metrics of mission completion and mission completion time, they are of less value.

Q154.  What are the rough dimensions/size scale of obstacles in the course? The answer to this question drives sensor range performance.

> A154.  DARPA expects the length of the course to be 1km or less.  However, DARPA reserves the right to make the course longer if the teams have demonstrated mastery of shorter courses. DARPA expects obstacle size to vary substantially, from smaller than the GFE Platform to large buildings.

Q153.  What materials are the obstacles made of? The answer to this question drives the performance of sound-based sensors (such as sonar rangefinders) which depend on acoustically reflective materials.

A153.  DARPA expects to conduct testing in a wide variety of real-world settings, possibly including desert, woodland, mountain, and urban terrain.

Q152.  The BAA defines research as "federally funded fundamental research at colleges, universities, and laboratories."  Does research performed by a small business fall into this classification as well?  How will proposals led by small business be evaluated relative to university led teams?

A152.  The BAA does not define *research* as "federally funded fundamental research at colleges, universities, and laboratories;" rather, Section II.B of the BAA provides the definition of *fundamental research* as it pertains to the application of publication restrictions on research performed under the FLA program--regardless of the type of entity performing the research.   Furthermore, the proposal evaluation criteria apply equally to all proposals--regardless of the proposer entity type. See Section V.A for the specific evaluation criteria as well as Section V.B for an explanation of the review process.

Q151.  The BAA says, "The poorest test performance for each team will not be included in the final composite score." Does this imply that a slow run to perform mapping might be used to inform subsequent runs?  What information transfer is allowed between successive runs through the course?

A151.  No information transfer is allowed between runs at Government-run tests.  DARPA reserves the right to change this policy if necessary.

Q150.  The BAA says, "Communications: To enforce autonomous operation, the FLA tests will prohibit communications between operators and the vehicle after an initial "Go" command." We understand that we will be evaluated based on our autonomous software, but can abort, stop or landing commands be provided to ensure the safety of the vehicle and the surroundings (with an appropriate penalty)?

A150.  DARPA expects to use the handheld controller for the GFE Platform to ensure safety.  One usage mode is for the safety officer to use the controller to switch the vehicle out of autonomous mode and take control of the vehicle.

Q149.  The BAA says, "Since resumes count against the proposal page limit, proposers wish to include them as links in subsection viii. Personnel, Qualifications, and Commitments."  What does links mean in this context; does this mean links to CVs that are published on line for example (thereby reducing the space requirements)?

A149.  Yes, that is correct.

Q148.  If we have a 3D Printing Lab capable of manufacturing micro drones, would there be an opportunity to participate in the FLA program?

A148.  The focus of the FLA program is on development and demonstration of algorithms and representations, and not on manufacturing.

Q147.  Section III, Part A, Paragraph 2 (page 13) of the BAA on Foreign Participation seems to admit foreign participation, but is conditional on compliance with other regulation such as export control law. Our export control officer identified many sections related to UAVs.  In at least some sections,

vehicles with a range less than 300 km or work on "model aircraft" are exempted. Would the FLA program be willing to provide an opinion on whether their program technologies are subject to export control?

A147. The BAA states that the program goals "may be met by proposers intending to perform fundamental research." Fundamental research would not be subject to export control restrictions. That said, performers do need to be aware of UAV restrictions in the ITAR and EAR and must comply with the appropriate regulations if their research crosses over into those parameters.

Q146. If accepting FLA funding from DARPA would affect the commerce control list classification of any product that emerges from this research, would accepting funding from DARPA lead to ITAR classification for any hardware and software combinations for teams focused on developing commercial hardware and software combinations?

A146. DARPA funding would not automatically trigger a change in an item classification either on the Commerce side or on the Department of State side. Performers could submit a Commodity Jurisdiction request to the Department of State if they are unsure whether something would be ITAR or EAR controlled. DARPA funding would be one of several factors in the decision-making process.

Q145. What are the specs of the gyro and barometer?

A145. This information will be provided at the program kickoff meeting.

Q144. We have developed a sense and avoid obstacle detector, patented it, and licensed it. Does that discount us from participation in the program?

A144. We are not able to comment on the suitability of unsolicited documents for the FLA BAA. It is up to you, alone, whether or not to submit a proposal in response to the FLA BAA. You may consider using the teaming website to find suitable partners.

Q143. For this BAA, is there any preference towards which type of award instrument is used "procurement contract" or "grant"?

A143. There is no preference. Per Section III.A of the BAA, the Government Contracting Officer will select the most appropriate award instrument depending upon the nature of the work proposed, the required degree of interaction between parties, and other factors.

Q142. For multi-organizational teams, does there need to be a prime who issues subcontract (subawards), or is it possible to have interrelated but separate awards to each organization on the team?

A142. DARPA will award to a prime awardee who will be responsible for placement and management of subawards.

Q141. Clause (9) Subcontractor Costs states that we must provide above information for each proposed a cost or price reasonableness analysis of proposed subcontractor prices as defined in FAR 15.404-3. Such analysis shall indicate the extent to which the prime contractor has negotiated subcontract prices. What exactly should we provide? What do you mean by analysis?

A141.  Prime contractors should review subcontractor proposals and provide an analysis of whether or not the proposed costs are necessary and reasonable (See FAR 15.404-1(b)(2)) to accomplish the effort proposed.

Q140.  What is the acceptable overhead rate?
A140.  Proposed overhead rates will be analyzed by the Contracting/Agreements Officer as to their reasonableness.  See Federal Acquisition Regulations Par FAR 15.404-1(b)(2 for guidance on reasonableness.

Q139:  What is necessary for a small company to prime a DARPA contract?  Are there any requirements other than having a DCAA-compliant accounting system?
A139: Contractors have to demonstrate to the Contracting/Agreements Officers that they are "responsible".  The term responsible has different implications. FAR 9.104-1 covers the general standards for a prospective contractor to be determined responsible. To be determined responsible, a contractor must:

- have adequate financial resources to perform the contract, or the ability to obtain them;
- be able to comply with the required or proposed delivery or performance schedule, taking into consideration all existing commercial and government business commitments;
- have a satisfactory performance record;
- have a satisfactory record of integrity and business ethics;
- have the necessary organization, experience, accounting and operational controls, and technical skills, or the ability to obtain them;
- have the necessary production, construction, and technical equipment and facilities, or the ability to obtain them; and
- be otherwise qualified and eligible to receive an award under applicable laws and regulations.

Further, a DCAA compliant accounting system is preferred but, in certain cases, DARPA can use other types of contracts if an approved system is not in place.

▲▲▲New Q/A▲▲▲

Q138.  We are having trouble logging in to the website at https://baa.darpa.mil. Could you please help activating the account?
A138.  Per BAA Section IV.E.1.a, technical support for the DARPA BAA Submission website (https://baa.darpa.mil) may be reached at BAAT_Support@darpa.mil.

Q137.  I understand that we should apply on the grants.gov website and should upload volumes 1+2 into the application package.  Is this correct?  Which additional information should we attach to the application package?
A137.  Section IV.E.1 of the BAA provides submission instructions.  Proposals requesting a grant or cooperative agreement may be submitted to the grants.gov website; proposals requesting a procurement contract or other transaction should be submitted via https://baa.darpa.mil.  Section IV.B of the BAA describes the content and form of the

application package.

Q136.  In addition to the 20W solution, are you also interested in the 20mW solution? That would require a tight coupling between algorithm, sensor, and computation development, likely with each requiring highly specialized designs. But if successful it would be a paradigm shift away from inefficient, general purpose computation and sensors to mission-specific custom solutions with unprecedented performance.

    A136.  As stated in Section I.F on Performance Metrics, the objective is to complete specified missions as fast as possible.  Power budget is not considered a performance metric for the FLA program.  A 20mW solution would be within scope for the FLA program.  Additionally, see Q/As 5, 10, and 26.

Q135.  Can you please give a couple of examples about how <u>indoor</u> mission goals will be designated (similar to the example that was given in the BAA for the outdoor missions), and/or what the mission objectives of the indoor test events will be?  (Example questions: Is a valid objective to transit to a designated room or landmark as quickly as possible after entering the building? Is a valid objective to explore an unknown building and report back to the start with information about the layout of the building, i.e., some type of map of the building?  Is a valid objective to search an unknown building for specified objects that may be located in any room in the building?)

    A135.  Missions will not include searching for or recognizing a specific object. Additionally, see Q/As 38 and 50.

Q134.  What prior knowledge will be provided for the indoor portions of the mission, i.e., will outdoor overhead imagery also be used, such that the general shape of the building(s) is known?  Will a high-level layout of the internal building (including rooms and hallways, though possibly stale) possibly be provided?  Will any of the indoor test events not provide any prior knowledge?

    A134.  DARPA expects to provide some kind of prior knowledge for each test, whether indoor or outdoor.  However, DARPA reserves the right to provide little or no prior knowledge if the teams have demonstrated mastery of cases where prior knowledge is provided.  DARPA has not yet determined the format for the prior knowledge for indoor portions missions.  Additionally, see Q/As 36 and 120.

Q133.  What is the maximum rate that the information listed in the feedback section of Attachment 5 (Rev. 1) can be provided through the GFE API?

    A133.  See Q/A59.

Q132.  Which, if any, of the sensors listed in the feedback section of Attachment 5 (Rev. 1) are included in the GFE?

    A132.  An accelerometer, gyroscope, and barometer will be included in the GFE.  Data from these sensors will be available through the API.

Q131.  What is the maximum rate that the GFE autopilot flight controller accepts commands through the API?

    A131.  See Q/A41.

Q130.  Must performers interface with the GFE motors and GFE sensors through the API to the autopilot flight controller, or can we bypass the API and directly interface with the hardware?

> A130.  Performers must use the provided API, and may not bypass the API.  Any sensors (lasers, cameras, etc.) that the team adds will NOT be accessible through the API, so the teams will need to interface to the sensors they add to the vehicle.

Q129.  Is any additional documentation is currently available from the VeloHex supplier concerning flight capability and dynamics (max acceleration and deceleration, turning radius at various speeds)?

> A129.  See Q/A46.

Q128.  In the SAM system to get a CAGE code, electronic funds transfer information is required. We have an account in a non-United States bank. Is this an impediment to get the CAGE code?

> A128. See Q/A127.

Q127.  We have some doubts about acquiring the DUNS number, TIN number and CAGE code specified in the BAA (section b. Volume 2 - Cost proposal, i. Cover sheet: items (13),(14) and (15), page 20 of the BAA). In the link provided to get a TIN number, do we need the EIN type? Can we get one as Non-U.S. organization?

> A127.  Per Section VI.B.7 of the BAA, all proposers must be registered in the System for Award Management (SAM).  See the SAM User Guide (https://www.sam.gov/sam/SAM_Guide/SAM_User_Guide.htm#_Toc330768973) for further information on SAM registration, including requirements such as TINs, CAGE codes, etc. for U.S. and non-U.S. organizations.  In particular, see Appendix B of the SAM User Guide.

Q126.  Would a 0.6M/year subcontract to a foreign university by a foreign company be unusual?

> A126.  It is up to each proposer to determine team makeup and breakdown of costs.  See Section V.A of the BAA, which identifies the proposal evaluation criteria, including Cost Realism.

Q125.  Section IV.E.1.a of the BAA states, "All full proposals submitted electronically through the DARPA BAA Submission website must be uploaded as zip files (.zip or .zip extension)".   Can DARPA provide zip software?

> A125.  No.  Proposers may find several different free versions of zip software on the internet.

Q124.  Are we permitted to swap out the provided flight controller and use our own controller?

> A124.  No.

Q123.  Is the use of Mavlink protocols acceptable and does the flight controller accept it?

> A123.  No.  The API provided with the vehicle will be used to interface with the vehicle.

Q122. The Proposers' Day webcast indicated there is a flight controller; where can we find more details?

> A122.  See Attachment 5 (Rev. 1) of the BAA.

Q121.  Can DARPA define the test conditions in any more detail? In particular, will any tests require round-trip flight, e.g., return to the start? Are any of the tests likely to require backtracking during movement to the goal, e.g. should we expect dead ends? What is the aircraft supposed to do inside the warehouse and offices, e.g. just fly around avoiding collisions, or do some explicit search, or what?

>    A121.  See Q/As 25, 38, 51, 55, and 68.

Q120.  How will the door/window to be entered be designated? For example, will there be a prior image in the prior knowledge that shows it? If not, how else will the ingress point be described? Will there be more than one such feature the aircraft has to choose among?

>    A120.  DARPA intends to designate ingress points by marking them on overhead imagery supplied in advance of a test.  However, DARPA reserves the right to develop and use other designation methods.  There may be more than one ingress point for a building, and the UAV could use any of them.

Q119.  The BAA seems to be unclear with regard to whether you are providing some autopilot software for the gigabyte i7 brick since it states that the following is out of scope/funding: "Mobility, including improvements to the GFE Platform airframe and supplied autopilot firmware."  Are you providing software (firmware) or was it a misprint for hardware?

>    A119.  The GFE Platform includes autopilot firmware, and teams may not modify that firmware.  The intent is for teams to develop software that runs on the i7 computer (or another computer supplied by the teams) that performs autonomous flight.

Q118.  The BAA does not state what operating system (if any) to use on the i7 gigabyte board: Microsoft windows or Linux based?

>    A118.  See Q/A95.

Q117.  Is FY15 (assumed to be fiscal year) Q3 kickoff assumed to be May 15, 2015?

>    A117.  The exact date of the kickoff has not been set yet, but is expected to take place during the third quarter of the Federal fiscal year, which runs from April 1, 2015 through June 30, 2015.

Q116.  Can coordinates with respect to the supplied overhead map be retained in order to support progress awareness?

>    A116.  DARPA does not expect to rely on global coordinates in any of the Government-run tests.

Q115. Would DARPA consider postponing the Feb 5 submission deadline?

>    A115.  No.

Q114.  How may we obtain a furnished government VeloHex drone unit that is in the video referenced in Attachment 5?

>    A114.  DARPA will supply the GFE platforms at the program kickoff meeting.

Q113.  Can you please provide us access to the software/API so we can compile and evaluate on our intended processor platform.

>    A113.  The API will be provided at the program kickoff meeting.

Q112. Can you please provide the drawings suggested for the GFE UAV platform.
    A112. The drawings will be provided at the program kickoff meeting.

Q111. Can you please provide any information on Sample Config#1 and Sample Config#2.
    A111.  See Attachment 5 of the BAA.  Note, amendments to the BAA and Attachment 5 were published on www.fbo.gov on 1/13/15.

Q110.  Can you please provide any information on the dependency of maximum acceleration of the GFE UAV on the direction of motion in all directions.
    A110.  The maximum acceleration at any time will depend on the vehicle configuration and the state of the vehicle.  The maximum total thrust is approximately 3600 grams in still air. With the provided API, a user can attempt to design and perform tests to characterize the various aspects of the behavior of the vehicle that are of interest to the user.

Q109.  Will the overhead image in outdoor missions cover the complete mission area (so that it can be used for localization), or will it only show the target area? In the latter case, will an initial direction to the target be provided?
    A109.  The overhead image will cover the complete mission area.
Q108.  Will KMel / DARPA be providing dynamic model information, actuator and propeller dynamic characterization models or data, or other model information to support high performance control?
    A108.  See Q/A46.

Q107.  Can performers request multiple copies of the GFE platform, so that collaborators at different sites may continuously have vehicles to work with? Is there a limit on how many copies may be requested?
    A107.  See Q/A42 and 43.

Q106.  Is there a simulation environment for the VeloHex for the simulation and development of control algorithms.
    A106.  DARPA will not provide a simulation environment.
Q105.  Are you open for fast and simple sense and avoid system for small UAS or you are looking for algorithm and software only?
    A105.  The focus of the FLA program is on development and demonstration of algorithms and representations.

Q104.  There is a disconnect between the BAA and Attachment 5.  The BAA states: "The GFE Platform will include the airframe, a suite of commercially available sensors, commercially available processors, and an Application Programmer Interface (API) to the on-board autopilot flight controller."  Attachment 5-GFE Platform states: Peripherals (not included): CPU (Gigabyte i7 mini-PC), Top LIDAR (Hokouyo UTM-30LX), Bottom LIDAR (Hokouyo UST-20LX), cameras (4x USB mvBlueFOX).  Please clarify.  Are peripherals delivered with the platform?  Are they the peripherals listed as optional in Attachment 5?
    A104.  See Q/A7.

Q103. Is foreign university participation acceptable for FLA?
    A103.  See BAA Section III.A.2

Q102.  Do you already have a team put together for the testing side of FLA?
A102. Test and evaluation is out of scope for this solicitation, as stated in the BAA, Section I.C, pp. 6-7.

Q101.  Is there any overlap between the capabilities you are developing and the NIST USAR aerial testing standards?
A101.  The focus of the FLA program is on development and demonstration of algorithms and representations.  This focus is independent of standards.

Q100. Are swarm implementations applicable for this proposal?
A100. The term "swarm" implies a large number of vehicles.  FLA testing will involve a single vehicle.

Q99. Regarding the sensors and other hardware that we decide to use, would it be possible to modify our design during the whole development period? How specific should the hardware design be at time of submitting our proposal?
A99.  Yes, performer teams may modify their designs during the course of the program.  Indeed, DARPA encourages rapid experimentation to determine what works, and innovation to make it work better.

Q98. Does DARPA view utilizing the ROS and GAZEBO framework as an advantage?
A98.  The BAA does not specifically identify ROS or GAZEBO.  DARPA does not endorse any specific product or framework.  To the extent that the BAA encourages development of open source design and software, to that extent ROS and GAZEBO may be considered advantageous by virtue of their being open source.

Q97. Will KMel provide a GAZEBO model of the UAV?
A97.  No.

Q96. Will you provide a ROS interface for the platform?
A96.  Yes, a ROS interface for sending commands and receiving feedback data from the vehicle will be provided.

Q95. What operating systems are supported?
A95. The API will be supported on Ubuntu 12.04.  The API should work on other Linux distributions but will not be officially supported.

Q94. Do the platform flight control and power management systems run on a dedicated processor or on the same processor as the autonomy?
A94. The flight controller runs on a dedicated processor, distinct from the processor for autonomy.

Q93. Does DARPA expect only single agent solutions, or is there a multi-agent collaboration solution also envisioned for this program?  If so, will DARPA provide the equipment to do that?
A93. See Q/A71.

Q92. Is a basic aero-model provided along with the provided equipment (GFE)? Alternately, will the teams need to learn the platform's aero-model from scratch?

A92. No.

Q91. What kind of overhead reference imagery will be provided (e.g., Satellite, Airborne, Open Street Map, Google Earth, BluePrints)?

A91. See Q/A25.

Q90. Can performers take advantage of learning algorithms during a given test event?  That is, will the obstacle course remain static from run to run during a given test event?

A90. It is up to the performer teams to determine what algorithms to use.  Additionally, see Q/A24.

Q89. What are the expected wind and temperature ranges for the test events?

A89. DARPA intends to conduct tests under moderate, non-extreme conditions.  However, no values have been determined for maximum wind speed, minimum temperature, or maximum temperature.

Q88. From Slide 5 of Dr. Micire's Proposers' Day presentation (posted at http://www.darpa.mil/Opportunities/Solicitations/DSO_Solicitations.aspx), can you offer additional information distinguishing between the Global Maps listed under Deliberative Autonomy (considered out of scope for FLA) and the Topological and Geometric Maps listed under Perceptive Autonomy (considered in scope)?

A88. The intent is to distinguish between more conventional representations (for example, representing the environment as a collection of three-dimensional points) and less conventional representations (for example, representing the environment as a collection of topologically connected regions or a collection of polyhedra).

Q87. Should GFE availability and cost be excluded from the total budget or should this be included? What is the cost to be set aside if GFE is to be included in the Program budget?

A87.  Costs for the GFE Platform should be excluded from proposals.

Q86. Does the proposer have access to GFE prior to the proposal submission date for any dry-runs?

A86. No.  DARPA intends to supply the GFE Platforms at the program kickoff meeting, and not before.

Q85. Can international commercial or education institutions participate as teaming partners or collaborators?

A85. See BAA Section III.A.2

Q84. Do proposers have access to the planned locations prior to proposal submission date?

A84.  No.  Proposers should use the locations listed in Table 2 of the BAA only for cost estimation purposes.  The exact test site locations remain to be determined.

Q83. What imagery data will be provided (file formats, etc.)?

A83. See Q/A25.

Q82. Is the 20mps speed to be achieved during the flight so as to be considered a success? Is this the average speed of total flight, or maximum speed achievable at any instance?
A82. See Q/A73.

Q81. What is the maximum achievable speed of the Government Furnished Equipment that has been field-tested so far?
A81. Faster than the requirements of the BAA.

Q80. For technology that is already licensed to industry partners, possibly in an overlapping field of application, what are the IP requirements for use of this technology in a team's developments?
A80. See section VI.B of the BAA.

Q79. The BAA states that sensor development will not be funded, but obviously some potentially useful sensors are advanced prototypes. What will be considered a reasonable budget for these advanced prototypes, which could require customization to the platform?
A79. It is up to the proposer to determine the costs. Additionally, see Q/As17 and 18.

Q78. What will be the interface from gigabyte PC to the flight controller? Will an API (for Linux) be provided for this?
A78. The interface will be serial communication via UART and FTDI Serial-to-USB converter. C++, Matlab and ROS APIs will be provided.

Q77. Can you elaborate on what level of sensor development is allowable?
A77. See Q/As 17 and 18.

Q76. Is there an embedded flight computer onboard the UAV (distinct from the GIGABYTE computer)?
A76. Yes.

Q75. What kind of output rates will be available for a fairly complete message from the onboard controller (battery voltage, attitude, angular rates, accelerations, baro pressure, etc.)?
A75. See Q/As 64, 65, 66, and 67.

Q74. What is the smallest cross-sectional area (Height and Width) we will be required to pass through to satisfy goals?
A74. See Q/A28.

Q73. Speed is listed as performance goal. Is this maximum capability or average speed? Is time to target a performance goal?
A73. Section I.F identifies the performance metrics as mission completion and mission completion time. While Section I.F does not list either the maximum speed or the average speed as a performance metric, higher speeds will generally reduce mission completion time.

Q72. Is it possible to get an extension to the submittal date?

A72. No.

Q71. Are we assuming single vehicle operation, or is there any interest in multi-vehicle operations where the individual vehicles communicate with each other -- perhaps warning of hazards if one crashes, etc.
A71. FLA testing will involve a single vehicle.

Q70. For a multi-institution team, will multiple GFE be supplied such that each institution can have test vehicles, or will the GFE be limited to "one set" for the overall team?
A70. See Q/As 42 and 43.

Q69. Will the environments consist of multiple floors? The BAA seems to only talk about what amounts to a 2-dimensional problem (clutter, doors, windows, offices, slalom course, etc…).
A69. Testing may involve multiple floors. DARPA intends to design tests that challenge the performer teams. If the performer teams demonstrate mastery of single floors, then DARPA would escalate to multiple floors.

Q68. Is there a percentage of square footage that needs to be observed and documented? Or does the drone simply need to enter the environment and find its way out without crashing?
A68. No, square footage coverage is not a performance metric. Yes, the vehicle needs to traverse the environment to complete the designated mission. Consider an example where the mission was specified as visiting 10 rooms. If the vehicle visited 8 and did not visit 2, the coverage for this example would be 80%. Additionally, see Q/A55.

Q67. What is the weight of the i7 Gigabyte PC in the KMEL sample configuration?
A67. Approximately 200 grams.

Q66. What is the UART communication speed?
A66. See Q/A41.

Q65. What is the (max) update rate of the attitude?
A65. The onboard attitude estimate updates at 500 Hz.

Q64. What (max) update rate is available for direct rpm control?
A64. 500 Hz.

Q63. What are success criteria to progress from one phase to the next?
A63. See Section I.F (Performance Metrics).

Q62. Will (how will) DARPA collect telemetry to evaluate milestone testing? If so, will it be shared with performers? If not, are performers expected or allowed to do this?
A62. DARPA does not currently intend to collect telemetry for test and evaluation. However, DARPA reserves the right to collect telemetry. DARPA does not currently expect performers to collect telemetry. Before allowing performers to collect telemetry during tests, DARPA would need to assess safety and performance impacts.

Q61. On Page 5 of the BAA, the Prior Knowledge subsection talks about overhead reference imagery. This implies that UAVs will likely need a downward-looking camera to be able to match against that during testing to detect goal. Can you talk about this?

A61. It is up to the teams to determine the sensing approach that maximizes the performance metrics stated in Section I.F (mission completion, mission completion time).

Q60. To clarify in the BAA, are the Service Academies (for example, Air Force Academy) not eligible for grants?

A60. Per the BAA, military educational institutions (e.g., the Service Academies) are subject to applicable direct competition limitations and must establish their eligibility to propose to the BAA as primes or subs. Section III.A.1 for specific information on establishing eligibility.

Q59. At what rate will we get raw sensor measurements from the platform?

A59. The rates depend on the specific sensor: attitude estimate, angular rates, linear accelerations: up to 500hz; pressure: up to 45Hz; motor feedback: up to 125Hz for each motor. All rates are subject to change. All rates are configurable as a fraction of the maximum rate (1, 1/2, 1/3, 1/4, 1/5, etc. where 1 is maximum rate of the particular data).

Q58. What are the expected environmental conditions for the missions (dark, sunny)?

A58. See Q/A32.

Q57. What are some of the worst case physical obstacles we should be concerned about (bushes, trees, and walls are one level of difficulty while wires, power lines, and other small thin obstacles are a greater challenge.)?

A57. FLA testing will not focus on thin obstacles such as wires or power lines. However, DARPA reserves the right to include such obstacles if the teams have demonstrated proficiency in navigating thicker obstacles.

Q56. Since indoor and outdoor environments can have very different sensing requirements, is it reasonable to use different sensor packages for different tests, or should we assume a single sensor package for all tests?

A56. DARPA encourages teams to experiment with different approaches for sensing, computing, and algorithms during the program. Therefore, different sensors, computers, and algorithms may be used for different tests. However, for the ultimate Full Mission test, only a single configuration may be used.

Q55. The testing schedule shows things like: "Slalom", "warehouse interior", "indoor office". Given that GPS is denied, how will success/goals be defined? Something like: proceed 100M in this direction without hitting anything (good for slalom). How will success in exploring interior spaces be defined? Explore until "complete"?

A55. For the example of traversing the interior of a warehouse, the mission would be considered complete if the vehicle launched from the take-off point, entered the warehouse, flew around inside the warehouse, exited the warehouse, and traveled to the destination area. There is no penalty assessed if the vehicle strikes a solid object; if the vehicle strikes an object and cannot continue, then the run will "score" lower than if the vehicle can continue and complete the mission.

Q54. Is there a ballpark number (or range) of teams anticipated?
>A54.  No.

Q53. In the 6<sup>th</sup> bullet under "outside the scope" under "D. Program Scope," it is mentioned that no funding will be provided for spatial mapping including SLAM. Can you confirm that it would be acceptable to request funding to 'harvest' and adapt existing algorithms from within that body of research if it contributes to the stated program goals?
>A53.  Yes, proposals may request such funds.

Q52. In the last bullet of "within the scope" under "D. Program Scope," it is mentioned that teams may add processors and make minor adaptations to them. Can you confirm that this includes the use of non-traditional processors such as FPGA's (Field Programmable Gate Array) and GPU's (Graphics Processing Unit)?
>A52.  Yes, as long as they are not invented or developed with FLA funds.

Q51. Does the mission profile assume that the vehicle will return to its start location, or do we just need to demonstrate arriving at some target goal?
>A51.  Different missions may have different profiles.  Some missions may involve returning to the start location.  Other missions may involve returning to a different location.

Q50. The solicitation mentions performance metrics with respect to missions. However, there is no mention of any missions. Can you give examples of the types of missions or an example mission you expect the vehicle to perform?
>A50.  Missions begin from a designated take-off point, travel through the environment, and end at a designated destination area.  Figure 1 in Section C of the BAA identifies representative environments of interest, including outdoor terrain with "slalom-style" obstacles, a warehouse interior, indoor offices, doors, and windows.

Q49. Is the budget limit of $5.5M for total costing for all 3 phases?
>A49.  Yes.

Q48. Do the provided dimensions of the vehicle include the prop guard?
>A48.  Yes.  All vehicle specifications are subject to change.

Q47. Are FPGAs acceptable as the computing platform (in place of the provided i7)?
>A47.  Yes, as long as they are not invented or developed with FLA funds.

Q46. Can we get any info about the dynamics and control authority for the vehicle, e.g., any information about its max angular rates?
>A46.  Minimum and maximum propeller speeds and nominal propeller thrust versus propeller speed data will be provided.  The maximum angular rate is a function of the exact configuration of the vehicle and is not presently known. With the provided API, a user can design and perform tests to characterize the various aspects of the behavior of the vehicle that are of interest to the user.

Q45. Will we be allowed to modify the vehicle at all, or are we only allowed to strap things onto it? For example, can we drill and tap holes or add spacers between the top and bottom plates to make more room in the middle?

> A45. Yes, teams can drill and tap holes. Teams may add spacers to provide support for sensors. However, teams may not make major structural changes to the vehicle without prior approval by DARPA.

Q44. Can we get 3D models of the vehicle?

> A44. DARPA will provide engineering drawings of the vehicle, but not a 3D model.

Q43. Will performers be able to purchase their own vehicles?

> A43. While DARPA will not prohibit the purchasing of vehicles, the proposer would need to present a compelling case to use Government funds for the purchase.

Q42. How many vehicles will each performer get?

> A42. Each team will receive two GFE Platforms at the kickoff meeting at the beginning of Year 1. Each team will receive up to two additional vehicles at the beginning of Year 2, if needed. Each team will receive up to two additional vehicles at the beginning of Year 3, if needed. The intent of providing these vehicles in Years 2 and 3 is to encourage teams to experiment aggressively and often.

Q41. What is the comms rate for the "low-latency" UART comms?

> A41. Users can set the following UART rates for the communication interface: 57600, 115200, 230400, 250000, 500000, 921600, 1000000, 2000000. These rates use the 8N1 configuration.

Q40. Is there a penalty for carrying the maximum payload of 900g - 1100g or is there any advantage for minimizing the payload?

> A40. Section I.F identifies the performance metrics and does not include the payload mass. So, from a scoring point of view there is no advantage or penalty for smaller or larger payload masses. However, lower payload mass generally increases endurance and maneuverability.

Q39. What is the expected flight time?

> A39. DARPA expects test missions to last no more than 10 minutes.

Q38. What is the goal of the test? Is it to fly through from start point to designated end point through the obstacles?

> A38. Yes. Further, the goal is to complete the given mission as fast as possible, as described in Section I.F Performance Metrics.

Q37. Are there any limitations on the path through the slalom in Phase 1?

> A37. No.

Q36. What prior knowledge of the obstacles is given?

> A36. For each test, DARPA will provide a Test Plan that describes the general terrain. This

information will not define or identify obstacles.  It is up to the teams to determine that.

Q35. What prior knowledge of the landmarks are given (e.g., shape, rough location, or number)? Are landmarks knowledge available in the prior map?
> A35.  See Q/A34.

Q34. What constitutes a Landmark? Are landmarks visual-only, or spatially distinguishable?
> A34.  DARPA will not define landmarks.  It is up to the teams to determine navigation methods, including definition of landmarks.

Q33. Do the 2 performance metrics given in the BAA apply to both outdoor and indoor tests? Are these the only criteria?
> A33.  Section I.F of the BAA identifies all of the program's performance metrics, which apply to all tests, whether indoor or outdoor.  There are no additional performance metrics.

Q32. What lighting condition is assumed? Is the UAV required to fly in dim light or pitch-dark conditions?
> A32. All test and evaluation will take place during the day.  Some indoor areas may have dim light.  No test and evaluation will take place under pitch-dark conditions.  This should not limit proposers from considering technologies to enable night operations.

Q31. What is the expected ending TRL of this project?
> A31.  A specific expected TRL is not a defined requirement of the BAA.

Q30. How should repairs/replacement of the robot be budgeted?
> A30.  The GFE Platform developer will make reasonable repairs to broken GFE vehicles, at no cost to the teams.  Frequent repairs due to reckless operation are not considered reasonable.

Q29. Please clarify intellectual property status for algorithms developed under this program.
> A29.  See Sections I.K and VI.B of the BAA.

Q28. How small is the tightest "hole" the platform will be expected to pass through?  Will it be small enough to require the vehicle to be rolled or pitched in order to fit through the available space?
> A28.  During test and evaluation, the GFE Platform will fit through all openings without pitching or rolling.  See the BAA's Attachment 5 (Rev.1) for the GFE Platform's dimensions.

Q27. Can you please explain why SLAM is considered out-of-scope but other similar algorithm techniques (topological maps, loop closure) are considered within scope?
> A27. The focus of this BAA is to explore non-traditional perception and autonomy methods.  Other Government programs have already devoted considerable resources to SLAM.

Q26. Is choosing an architecture that uses a processor with far less than 20 W considered favorable relative to architectures that use the maximum available power budget, or is the objective to provide maximum capability provided that up to 20 W is available?  Similarly, is an architecture that uses less sensors considered favorable?

A26.  As stated in the BAA, Section I.F on Performance Metrics, the objective is to complete specified missions as fast as possible.  The power budget and the number of sensors are not considered performance metrics under this BAA.

Q25. Can you please provide additional information on the overhead imagery that is to be provided for the outdoor test case, such as approximate expected maximum and minimum resolution values?  This could have a significant impact on the proposed algorithm techniques to be used.
    A25.  The imagery will vary in resolution and may not reflect very recent changes.  The source, format, resolution, and similar parameters of the overhead imagery are presently unknown.  Additionally, see Q/A4.

Q24. Will environments be dynamic during the mission, i.e., will obstacles potentially be in motion?
    A24. The number of moving obstacles, and the motion profiles of moving obstacles, are presently unknown.  In general, DARPA will design the test and evaluation to challenge the teams.  If the teams demonstrate complete mastery of stationary environments, DARPA would emphasize dynamic environments.

Q23. Can you give some examples of how indoor and outdoor mission goals will be specified, given that no GPS will be onboard to tie goal locations to absolute coordinates?  (i.e., what are notional objectives / CONOPs for an FLA test event?)
    A23.  One example is to mark a region on an overhead image.  Another example is to specify a landmark, for instance, "the telephone pole."

Q22. Please explicitly describe what equipment is being provided GFE (including which sensors and processors, if any), and are performers allowed to augment this configuration and/or substitute alternate sensors/processors as long as they fit within the SWAP budget of the system?
    A22. Attachment 5 (Revision 1) describes the GFE Platform.  Also see Q/A7.  Teams may use alternate sensors and processors to maximize the performance metrics stated in section I.F.  Teams may not replace the supplied flight control hardware package.

Q21. If we are the prime, can we team with a federal lab?
    A21.  See BAA Section III.A.1 for guidance on teaming with federal labs.

Q20. The BAA states "The FLA program focuses on autonomy algorithms and software – specifically on sensing, perception, planning, and control – rather than on the flight hardware platform." Does this mean that this BAA is not focused on CMOS analog processors that offer extremely low latency and power consumption for image processing and state estimation in navigation?
    A20. The BAA does not prohibit use of CMOS analog processors, so long as they have been developed outside of this effort.

Q19. Our technology is designed around indoor application and it will take long for us to develop the outdoor functionality.  Is it possible to change the order of our demo?
    A19. No.  The order has been determined to progress from relatively lower to relatively greater clutter, and that is not subject to change.

Q18. We would like a general guideline for what constitutes "minor" vs "novel" in regards to sensor

modification.  For example, when using an image sensor, would "minor" cover changing the lens?  And, at what point, (for the same camera) does it become "novel"? – new FPGA, new processing circuits, removal of Bayer filters, new MLA, new micro optical bench/assembly, drivers, etc. Another way to look at this is might be what percentage of the total funding can/should be allocated to modifying hardware?

> A18.  With regard to your referenced example, changing the lens is considered a minor change, provided that the lens has already been developed.  Regarding the percentage of total funding dedicated to sensor modification, it is up to the proposer to determine the best allocation of engineering efforts.

Q17. The text of the BAA seems to suggest a strong preference, if not outright requirement, for conventional implementation technologies. For example, 'novel sensors' and 'novel processors' are specifically excluded from consideration for funding. However, many believe that conventional hardware approaches are *themselves* a significant roadblock to achieving the objectives of this program in miniature and especially micro-sized flying platforms. Serious arguments for this can be made in terms of size, weight, and power issues, as well as functional limitations (e.g., the potential for undersampling inherent with discrete-time imagers). The question is, how rigid is this conventional technology bias in the eyes of the sponsor? Is *any* developmental work on non-standard technologies permitted, if it can be shown that there is a solid possibility of meeting the program goals within the time frame of the program?

> A17.  DARPA believes that research is needed to develop new sensors and new processors. However, the BAA explicitly avoids those two topics.  Teams may use existing novel sensors and novel processors, but DARPA does NOT intend funding their development under this BAA.

Q16. Are there any restrictions on multi-organizational teaming?  For instance, would a two university team together with one or two small businesses be okay?

> A16.  The BAA imposes no restrictions on teaming.  DARPA encourages teaming, and has provided a teaming website to assist proposers in finding partners.  See Section VIII.B of the BAA.

Q15. Would DARPA also be interested in the software testing verification and validation methods used to develop the perception and autonomy software algorithms used for this demonstration program?

> A15.  DARPA is interested in test and evaluation, but will procure those services separately from the BAA.

Q14. On Page 7, Section D Program Scope, does modification of the existing motor drive method provided on the GFE Platform using advanced motor driver software algorithms that may be required for better performance fall outside the scope of this solicitation?

> A14.  Yes, changing the motor drivers falls outside the scope of the BAA.

Q13. On page 7, Section D Program Scope, it explains the GFE Platform has existing sensors. Can a list of these existing sensors be provided?

> A13. See Attachment 5.  Also see Q/A7.

Q12. On page 7, Section D Program Scope, it says the GFE Platform has existing processors. What

processors are used on the GFE platform? Is there also an Integrated Development Environment application software package suggested to program the provided processors?

> A12. Attachment 5 lists the processor on the GFE Platform. Teams may use any software development environment. Note, the BAA and Attachment 5 have been revised since originally published. See the amended documents at www.fbo.gov.

Q11. On page 6, Section C Program Structure, it explains that a clutter environment will be set up to test and evaluate the system. Will the clutter environment objects have any characteristics similar to what a bird or flying insect might sense such as smell, texture, size, moisture, color, brightness, sound, electric or magnetic fields, or motion?

> A11. The objects to be used for test and evaluation will have characteristics of real-life objects.

Q10. On page 5, Table 1, the requirement of "20 W computing" autonomy power is provided as a performance goal. Does this 20 W include the power required to drive the 6 motors on the GFE platform?

> A10. No.

Q9. Are there any quantitative objectives for size, weight, and cost of the sensors and processors? If so, must those be met within the program, or are plausible scalability arguments adequate, e.g., low cost sensors that are adequate for the autonomy research may easily be miniaturizable in a follow-on engineering development?

> A9. The FLA program has not defined requirements or objectives for size, weight, and cost. Section I.F of the BAA describes the performance metrics, namely, mission completion and mission completion time.

Q8. Regarding the program performance goals, is it required that the autonomous power be within 20 W for computing?

> A8. The 20 W is a goal, not a strict requirement. A team may use computing that requires more than 20 W, so long as the batteries contain enough energy to complete the mission.

Q7. What sensors and processors are included in the GFE Platform?

> A7. The originally published BAA and its accompanying description of the GFE Platform (Attachment 5) provided an incorrect list of the items included in the GFE Platform. Both the BAA and Attachment 5 have been amended to update and clarify the description of the Government-furnished Equipment (GFE) Platform in Part II, Section I.J and Attachment 5. The amended BAA and Attachment 5 are available at www.fbo.gov.

Q6. Will any of the tests require exploring cluttered spaces, as opposed to just doing high speed obstacle avoidance in cluttered spaces?

> A6. Some of the tests will require exploring cluttered spaces. Higher speeds are generally desirable.

Q5. Will any of the tests require revisiting places previously visited, and if so which ones?

> A5. Revisiting is not a requirement.

Q4. Regarding the overhead imagery as prior knowledge, how long in advance of the tests will that

be provided?

 A4.  DARPA anticipates that the lead time will be no less than one month prior to tests.

Q3. Is registration open to non-U.S. citizens?

 A3. Attendance is open to individuals who are U.S. Citizens, U.S. Permanent Residents, and Foreign Nationals. Registrants who are not U.S. Citizens must complete and submit a DARPA Form 60 (U.S. Permanent Resident and Foreign National Visit Request) no later than Friday, January 2, 2015 at 1:00 PM. This form and submission instructions are provided on the registration website.

Q2. The Proposers' Day Webcast information on page 37 of the file "DARPA-BAA-15-16.pdf" says the "Proposers' Day will be webcast on FRIDAY, January 6, 2015." However, the webcast is on TUESDAY, January 6, 2015, correct?

 A2. The webcast and Proposers' Day will be held on Tuesday, January 6, 2015. Amendment 1 to the BAA reflects this change.

Q1. I am very interested in the upcoming Proposers' Day webinar of January 6. I have a small time conflict, and it would be helpful if it is possible to view it later. Is it possible to view it at a later time?

 A1. No. The webcast may be viewed only during the scheduled time.